

LCA Compendium—The Complete World of Life Cycle Assessment (book series)

Series editors: Walter Klöpffer and Mary Ann Curran

Background and Future Prospects in Life Cycle Assessment

Editor: Walter Klöpffer, LCA Consult & Review, Frankfurt am Main, Germany

David Hunkeler

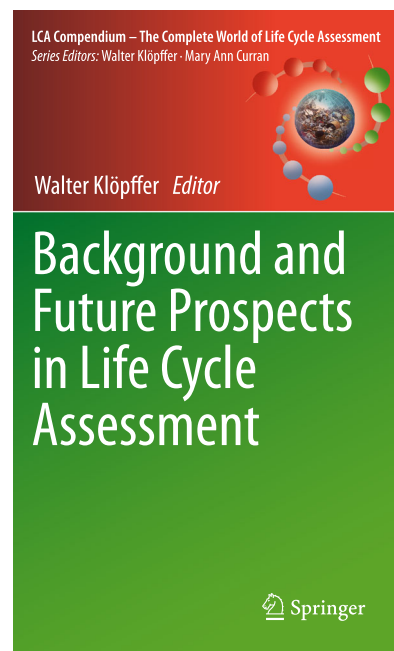
Received: 23 August 2014 / Accepted: 2 September 2014 / Published online: 26 September 2014
© Springer-Verlag Berlin Heidelberg 2014

Due to the steady, world-wide growth of the field of life cycle assessment (LCA), the wealth of information produced in journals, reports, books, and electronic media has made it difficult for readers to stay abreast of activity and recent developments in the field. This led to the realization of the need for a comprehensive and authoritative publication, the “LCA Compendium.” It is the first work of its kind. In March 2014, the first edition in this book series appeared entitled *Background and Future Prospects in Life Cycle Assessment*.

The book, edited by Walter Klöpffer, contains seven chapters, with an introduction, followed by four historical chapters on the role of the Society of Toxicology and Chemistry as well as the ISO 14040 standard, the UNEP/SETAC Life Cycle Initiative, and the International Journal of Life Cycle Assessment. It then concludes with an assessment of strengths and limitations, followed by a multi-authored chapter on current gaps and research needs.

This first edition in the book series includes contributions by the pioneers who have seen environmental assessment from the proto-LCAs four decades, hence, through its evolution, definition, development as a Code of Practice, and finally standardization. It is impossible to think of the field without these leaders, who really represent a collective parenthood of Environmental Life Cycle Assessment. Therefore, nothing could be more fitting than their reunion in press.

Chapter 1: “Introducing life cycle assessment and its presentation in the ‘LCA Compendium’” is authored by Walter Klöpffer. The chapter traces the roots of LCA from the early 1970s through the intensive workshops two decades later



culminating in the “Code of Practice” and the ultimate ISO standardization. The introduction defines life cycle assessment and presents it within the framework of sustainability, including the economic (costing) and social pillars. The stages of LCA are described, including the goal and scope definition, inventory analysis, and impact assessment. It also outlines the structure of the compendium and concludes by posing the question as to the scientific basis of LCA, relating it to various chemical and physical principles.

Chapter 2: “The role of SETAC in LCA development and application” is a contribution by James A. Fava, Andrea Smerek, Almut B. Heinrich, and Laura Morrison. The chapter,

D. Hunkeler (✉)
aquaTECH, Chemin du Chalet-du-Bac 4, 1237 Avully, Geneva,
Switzerland
e-mail: david.hunkeler@aquaplustech.ch

in addition to introducing SETAC, discusses the focus on environmental action as early as the 1960s. What began as an emphasis on pollution prevention, changed after the creation of the US EPA (1970). Some case studies are discussed including the debate on disposable and washable diapers and the mercury-free fluorescent bulbs. The history of SETAC's workshops and their various technical and advisory committees are summarized. The contributions of each of the intensive LCA workshops from 1990 through 1993, which finished with very well-cited books, are described in detail. Much of what LCA became is still own to the pioneering spirit and extreme dedication in these work-intensive meetings. The chapter concludes by previewing what is to come later in the book, including ISO and the UNEP/SETAC Life Cycle Initiative.

Chapter 3: "The International Standards as the constitution of LCA: the ISO 14040 series and its offspring" is penned by Matthias Finkbeiner, formerly in industry and presently an academic. The ISO 14040 series is discussed, including the 14040 and 14044 standards for LCA, as well as spin-offs, including single-issue LCAs such as water and carbon footprinting (14046 and 14067) and environmental product declarations (14025). The history of the standard and the various revisions are discussed in detail, as well as the role of the various international contributions to the development of the standard. There is a very concise and useful summary of the critical review process (ISO 14071) and, as in all the chapters, an extremely useful chronological glossary.

Chapter 4: "The UNEP/SETAC Life Cycle Initiative" is described by its pioneering managers and long-time leaders Guido Sonnemann and Sonia Valdivia. The review begins with a historic perspective on the founding of this unique program and then itemizes, in detail, the various contributions, including handbooks, database guidelines, and training documentation, to name just a few. The use of life cycle "thinking" in the private and public sectors is distinguished as is the use of the various tools to support decisions. There is a very helpful section for those who wish to implement the approaches which pose questions as a way of defining the specific approach required. The future, including globalization as well as defining key indicators, is highlighted.

Chapter 5: "Life cycle assessment as reflected by the International Journal of Life Cycle Assessment" has been summarized by long-time publishing editor Almut B. Heinrich. For the nascent life cycle community, two decades ago, the International Journal became one key demarcation of the arrival of the method. The chapter denotes the evolution, including metrics such as the citation index. It is important to note that this is one of the ten top-cited environmental journals and, very early on, provided online access and the provision of expanded manuscripts. The editor and publishing editor both

deserve an enormous credit for their work, which has really been a career-long vocation. The journal has always used a system of associate editors and has evolved, adding key subject areas as they arise. The historic development of national societies is also discussed, providing a history of those in Japan, India, Korea, Australia, and New Zealand. Specific projects such as SPOLD, for data consistency, as well as some EU projects are highlighted, as are the contributions of pioneers such as Helias Udo de Haes and Manfred Marsmann. There are long sections describing the introduction and development of the life cycle management section, a good example of how a dream comes into reality, as well as social LCA.

Chapter 6: "Strengths and limitations of LCA" are discussed by Mary Ann Curran, formerly of the US EPA. The chapter examines, among other topics, the questions of the time and resources required to obtain inventory data as well as the effect of missing data. It includes very recent work and, quite humbly, notes that LCA is not a solution for everything, does not always "declare a winner," and should be complemented by other tools. LCA is also distinguished from risk assessment. Examples of co-allocation, needed when a co-product is produced, and a discussion of system boundaries are also included. The chapter has a very unique government–industry perspective and also links LCA to established fundamentals, such as thermodynamic's energy balances. Usually, in science, we experimentally obtain data and evaluate a model against the measurements. In thermodynamics, it is the contrary; all data are evaluated against the Gibbs free energy equation. Environmental assessment may be similar in that we evaluate the quality of the data according to the framework, and not vice versa.

Chapter 7: "Challenges in life cycle assessment: an overview of current gaps and research needs" is the final chapter authored by fourteen active environmental management colleagues. It is motivated to provide a credible use of LCA and avoid over-interpretation of the results, as well as identifying, via sensitivity studies, gaps and limitations. Some examples of the gaps in inventory include water, renewable energies, carbon dioxide stored in biomass, as well as delayed emissions. A comprehensive section on the impact on human toxicity is aimed to inspire some future thought and further research, as many health effects are currently not considered in LCA. Issues such as micro/nano particles, noise, and odor are discussed. Ecotoxicity, biodiversity, and the often-neglected issue of land use are presented. Resource depletion including salinization, desertification, and changes in soil quality are discussed. The chapter concludes by presenting a need for further research at a time when industrials are asking for ways to use tools, and not an expanded set. LCA's future lies not only in its need for completeness, but in its ability to present itself to users in a way where its metrics can be tracked. As

some say, we have to be approximately right and not exactly wrong.

The references of the book are extensive, relevant, and up-to-date. The book's sole limitation, at least in the view of the reviewer, is that, for those who learn visually, it presents a relatively sparse selection of graphics. One might think that future additions might include a CD with some applications or even testaments. LCA was developed by many and I expect the future additions will include

some discussion from those, now retired from the field, including the Nordic perspective, co-developed by Lars-Gunnar Lindfors.

According to the LCA Compendium editors, which include the present editor Walter Klöpffer and Mary Ann Curran, the series is intended to complement the International Journal of Life Cycle Assessment. Jim Fava, in his foreword, heralds the series as a major undertaking to highlight the main drivers of LCA as well as its strengths, limitations, and needs.